

Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.

Inequalities in life expectancy among US counties, 1980-2014: temporal trends and key drivers.

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eTable 1: Counties combined to ensure historically stable units of analysis.

State	Group	Areas
Alaska	1	Kusilvak Census Area (2158), Wade Hampton Census Area (2270) ⁺
	2	Kobuk Census Area (2140) ⁺ , Northwest Arctic Borough (2188)
	3	Aleutian Islands Census Area (2010) ⁺ , Aleutians East Borough (2013), Aleutians West Census Area (2016)
	4	Dillingham Census Area (2070), Lake and Peninsula Borough (2164)
	5	Denali Borough (2068), Yukon-Koyukuk Census Area (2290)
	6	Hoonah-Angoon Census Area (2105), Skagway Municipality (2230), Skagway-Yakutat-Angoon Census Area (2231) ⁺ , Skagway-Hoonah-Angoon Census Area (2232) ⁺ , Yakutat City and Borough (2282)
	7	Ketchikan Gateway Borough (2130), Petersburg Borough (2195), Prince of Wales-Hyder Census Area (2198), Prince of Wales-Outer Ketchikan Census Area (2201) ⁺ , Wrangell City and Borough (2275), Wrangell-Petersburg Census Area (2280) ⁺
Arizona	1	La Paz County (4012), Yuma County (4027)
Colorado	1	Adams County (8001), Arapahoe County (8005), Boulder County (8013), Broomfield County (8014), Denver County (8031), Jefferson County (8059), Weld County (8123)
Florida	1	Dade County (12025) ⁺ , Miami-Dade County (12086)
Hawaii	1	Kalawao County (15005), Maui County (15009)
Maryland	1	Montgomery County (24031), Prince George's County (24033)
Montana	1	Park County (30067), Yellowstone National Park (30113) ⁺
New Mexico	1	Cibola County (35006), Valencia County (35061)
South Dakota	1	Oglala Lakota County (46102), Shannon County (46113) ⁺
	2	Jackson County (46071), Washabaugh County (46131) ⁺
Virginia	1	Fairfax County (51059), Fairfax City (51600)
	2	Rockingham County (51165), Harrisonburg City (51660)
	3	James City County (51095), Williamsburg City (51830)
	4	Prince William County (51153), Manassas City (51683), Manassas Park City (51685)
	5	Rockbridge County (51163), Buena Vista City (51530)
	6	Spotsylvania County (51177), Fredericksburg City (51630)
	7	Augusta County (51015), Staunton City (51790), Waynesboro City (51820)
	8	Pittsylvania County (51143), Danville City (51590)
	9	Greensville County (51081), Emporia City (51595)
	10	Albemarle County (51003), Charlottesville City (51540)
	11	Bedford County (51019), Bedford City (51515) ⁺
	12	Halifax County (51083), South Boston City (51780) ⁺

	13	Southampton County (51175), Franklin City (51620)
	14	Alleghany County (51005), Clifton Forge City (51560) [†]
	15	York County (51199), Newport News City (51700)

[†]County no longer exists due to boundary or name change.

eTable 2: Data sources used for covariates in the small area models.

Variable	Data Sources	Data Processing
Percent of the population age 25 and older who have completed high school	1980 census [1]; 1990 census [2]; 2000 census [3]; 2009-2014 ACS [4-9]	Linear interpolation was used fill in intermediate years between data sources. The rate of change calculated between 2007 and 2012 was applied to fill in estimates for 2013 and 2014.
Percent of the population who are Hispanic	1980 census [10]; 1990-2014 NCHS Bridged Race Files [11-13]	Linear interpolation was used to fill in intermediate years between data sources.
Percent of the population who are Black and some other race	1980-1989 Census Bureau Intercensal County Estimates by Age, Sex, and Race [14]; 1990-2014 NCHS Bridged Race Files [11-13]	Linear interpolation was used to fill in intermediate years between data sources.
Percent of land area in a Native American reservation	2013 Cartographic Boundary File, State-County for United States [15]; AIANNH Areas National Shapefile [16]	Geographic boundaries of AIANNH Areas were intersected with county boundaries using ArcGIS. The area of the intersection and the area of the county were calculated using an Albers Equal Area Conic projection. The proportion of the land area that is in a reservation was generated by dividing the area of the reservation by the total area in each county.
Household Median Income	1980 census [17]; 1989, 1993, 1995-2014 Small Area Income and Poverty Estimates [18]; 1980-2014 Bureau of Labor Statistics, Consumer Price Index [19]	Data were adjusted for inflation using the consumer price index, and linear interpolation was used to generate values between observed data points. Income was then log-transformed.
Population Density	1980-1989 Census Bureau Intercensal County Estimates by Age, Sex, and Race [14]; 1990-2014 NCHS Bridged Race Files [11-13]; 2013 Cartographic Boundary File, State-County for United States [15]	The area of each county was calculated using an Albers Equal Area Conic projection. The total population of each county was divided by the total area of the county, and was then log-transformed.

[1] Missouri Census Data Center. 1980 Census Summary Tape File 3, Table NT48A. MCDC Data Archive (Uexplore/Dexter). <http://mcdc2.missouri.edu/applications/uexplore.shtml>. Accessed April 22, 2013.

- [2] Minnesota Population Center. 1990 Census Summary Tape File 3, Table P057. National Historical Geographic Information System: Version 2.0. Minneapolis, MN: University of Minnesota 2011. <http://www.nhgis.org>. Accessed July 18, 2013.
- [3] US Census Bureau. 2000 Census Summary Tape File 3, Table DP2; using American FactFinder; <http://factfinder2.census.gov>. Accessed April 18, 2013.
- [4] US Census Bureau. American Community Survey, 2009 American Community Survey 5-Year Estimates, Table S1501; using American FactFinder; <http://factfinder2.census.gov>. Accessed April 17, 2013.
- [5] US Census Bureau. American Community Survey, 2010 American Community Survey 5-Year Estimates, Table S1501; using American FactFinder; <http://factfinder2.census.gov>. Accessed April 17, 2013.
- [6] US Census Bureau. American Community Survey, 2011 American Community Survey 5-Year Estimates, Table S1501; using American FactFinder; <http://factfinder2.census.gov>. Accessed April 17, 2013.
- [7] US Census Bureau. American Community Survey, 2012 American Community Survey 5-Year Estimates, Table S1501; using American FactFinder; <http://factfinder2.census.gov>. Accessed December 18, 2013.
- [8] US Census Bureau. American Community Survey, 2013 American Community Survey 5-Year Estimates, Table S1501; using American FactFinder; <http://factfinder2.census.gov>. Accessed December 23, 2014.
- [9] US Census Bureau. American Community Survey, 2014 American Community Survey 5-Year Estimates, Table S1501; using American FactFinder; <http://factfinder2.census.gov>. Accessed December 8, 2015.
- [10] Minnesota Population Center. 1980 Census Summary Tape File 1, Table NT8. National Historical Geographic Information System: Version 2.0. Minneapolis, MN: University of Minnesota 2011. <http://www.nhgis.org>. Accessed January 13, 2016.
- [11] National Center for Health Statistics, Centers for Disease Control and Prevention, US Census Bureau. United States Bridged-Race Intercensal Population Estimates 1990-1999. Hyattsville, United States: National Center for Health Statistics, Centers for Disease Control and Prevention, 2004. Accessed November 21, 2011.
- [12] National Center for Health Statistics, Centers for Disease Control and Prevention, US Census Bureau. United States Bridged-Race Intercensal Population Estimates 2000-2009. Hyattsville, United States: National Center for Health Statistics, Centers for Disease Control and Prevention, 2012. Accessed October 30, 2012.
- [13] National Center for Health Statistics, Centers for Disease Control and Prevention, United States Census Bureau. United States Vintage 2014 Bridged-Race Postcensal Population Estimates 2010-2014. Hyattsville, United States: National Center for Health Statistics, Centers for Disease Control and Prevention, 2015. Accessed December 18, 2015.

[14] US Census Bureau. Intercensal County Estimates by Age, Sex, Race: 1980-1989. <http://www.census.gov/popest/data/counties/asrh/1980s/PE-02.html>. Accessed January 8, 2015.

[15] US Census Bureau. TIGER/Line Shapefile, 2013 Cartographic Boundary File, State-County for United States, 1:20,000,000. <https://catalog.data.gov/dataset/2013-cartographic-boundary-file-state-county-for-united-states-1-20000000>. Accessed February 2, 2015.

[16] US Census Bureau. TIGER/Line Shapefile, 2012, Series Information File for the Nation, Current American Indian/Alaska Native/Native Hawaiian Areas (AIANNH) National Shapefile. <http://catalog.data.gov/dataset/tiger-line-shapefile-2012-series-information-file-for-the-nation-current-american-indian-alaska>. Accessed February 10, 2015.

[17] Minnesota Population Center. Summary Tape File 3, Table NT69. National Historical Geographic Information System: Version 2.0. Minneapolis, MN: University of Minnesota 2011. <http://www.nhgis.org>. Accessed November 12, 2015.

[18] US Census Bureau. Small Area Income and Poverty Estimates. <https://www.census.gov/did/www/saipe/data/statecounty/data/index.html>. Accessed December 28, 2015.

[19] US Bureau of Labor Statistics. Consumer Price Index: All Urban Consumers History, All Items 1913-2015. <http://www.bls.gov/data/>. Accessed March 24, 2015.

eTable 3: Data sources used for the regression analysis of variation in life expectancy.

Variable	Data Sources
Population living in households below the federal poverty line based on household income and size (%)	Small Area Income and Poverty Estimates [1].
Median household income (\$)	Small Area Income and Poverty Estimates [1].
High school graduates, age 25+ (%)	American Community Survey [2].
College graduates, age 25+ (%)	American Community Survey [2].
Unemployment rate, age 16+ (%)	BLS Local Area Unemployment Statistics [3].
Black population (%)	NCHS Bridged Race File [4].
American Indian, Native Alaskan, and Native Hawaiian population (%)	NCHS Bridged Race File [4].
Hispanic population (%)	NCHS Bridged Race File [4].
Obesity prevalence, ages 20+ (%)	Dwyer-Lindgren et al. [5], based on the Behavioral Risk Factor Surveillance System [6].
No leisure-time physical activity prevalence, age 20+ (%)	Dwyer-Lindgren et al. [5], based on the Behavioral Risk Factor Surveillance System [6].
Cigarette smoking prevalence, age 18+ (%)	Dwyer-Lindgren et al. [7], based on the Behavioral Risk Factor Surveillance System [6].
Hypertension prevalence, age 30+ (%)	Olives et al. [8], based on the Behavioral Risk Factor Surveillance System [6] and National Health and Nutrition Examination Survey [9].
Diabetes prevalence, age 20+ (%)	Dwyer-Lindgren et al. [10], based on the Behavioral Risk Factor Surveillance System [6] and National Health and Nutrition Examination Survey [9].
Insured population, age<65 (%)	Small Area Health Insurance Estimates [11].
Quality index	Dartmouth Atlas Project [12]. Following Chetty et al. [13], the quality index was constructed by taking the mean of the z-scores for six variables related to primary care access and quality among Medicare enrollees: the percent of enrollees who had an ambulatory care visit to a primary care clinician; the percent of diabetic enrollees

	who had an A1C test; the percent of diabetic enrollees who had an eye exam; the percent of diabetic enrollees who had an LDL-C test; the percent of female enrollees who had a mammogram; and the discharge rate for ambulatory care sensitive conditions.
Doctors per 1,000 population	Area Health Resource File [14].

[1] US Census Bureau. 2009 Small Area Income and Poverty Estimates. <https://www.census.gov/did/www/saipe/data/statecounty/data/index.html>. Accessed October 31, 2012.

[2] US Census Bureau. American Community Survey, 2011 American Community Survey 5-Year Estimates, Table S1501; using American FactFinder; <http://factfinder2.census.gov>. Accessed April 17, 2013.

[3] US Bureau of Labor Statistics. Local Area Unemployment Statistics: Labor Force Data by County, 2009 Annual Averages. <http://download.bls.gov/pub/time.series/la/>. Accessed December 14, 2015.

[4] National Center for Health Statistics, Centers for Disease Control and Prevention, US Census Bureau. United States Bridged-Race Intercensal Population Estimates 2000-2009. Hyattsville, United States: National Center for Health Statistics, Centers for Disease Control and Prevention, 2012. Accessed October 30, 2012.

[5] Dwyer-Lindgren L, Freedman G, Engell RE, et al. Prevalence of physical activity and obesity in US counties, 2001-2011: A road map for action. *Population Health Metrics*. 2013;11(1):7.

[6] Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System. <http://www.cdc.gov/brfss/>. Accessed July 24, 2013.

[7] Dwyer-Lindgren L, Mokdad AH, Srebotnjak T, Flaxman AD, Hansen GM, Murray CJ. Cigarette smoking prevalence in US counties: 1996-2012. *Population Health Metrics*. 2014;12(1):5.

[8] Olives C, Myerson R, Mokdad AH, Murray CJL, Lim SS. Prevalence, awareness, treatment, and control of hypertension in United States counties, 2001-2009. *PLoS ONE*. 2013;8(4):e60308.

[9] Centers for Disease Control and Prevention. National Health and Nutrition Examination Survey. <http://www.cdc.gov/nchs/nhanes.htm>. Accessed September 30, 2013.

[10] Dwyer-Lindgren L, Mackenbach JP, van Lenthe FJ, Flaxman AD, Mokdad AH. Diagnosed and undiagnosed diabetes prevalence by county in the U.S., 1999-2012. *Diabetes Care*. 2016;39(9):1556-62.

[11] US Census Bureau. 2009 Small Area Health Insurance Estimates. <https://www.census.gov/did/www/sahie/data/20082014/index.html>. Accessed June 8, 2016.

[12] The Dartmouth Atlas of Health Care. 2009 Selected measures of primary care access and quality. <http://www.dartmouthatlas.org/tools/downloads.aspx#primary>. Accessed June 16, 2016.

[13] Chetty R, Stepner M, Abraham S, et al. The association between income and life expectancy in the United States, 2001-2014. *JAMA*. 2016;315(16).

[14] Health Resources and Services Administration. 2014-2015 Area Health Resource Files: Total active non-federal MDs. <http://ahrf.hrsa.gov/download.htm>. Accessed October 12, 2015.

eTable 4: Principal component analysis of socioeconomic and race/ethnicity factors.

	Component							
	1	2	3	4	5	6	7	8
Poverty	-0.485	0.041	-0.080	0.256	-0.179	0.434	0.078	-0.681
Income	0.475	-0.028	0.174	0.146	0.311	-0.419	0.237	-0.627
High School	0.464	-0.207	-0.238	0.024	-0.026	0.298	-0.746	-0.195
College	0.397	-0.072	0.161	0.561	0.024	0.529	0.372	0.278
Unemployment	-0.298	-0.345	0.036	-0.044	0.862	0.193	-0.072	0.060
Black	-0.260	-0.476	0.295	0.568	-0.204	-0.404	-0.286	0.099
Native	-0.064	0.322	-0.731	0.485	0.209	-0.255	-0.019	0.114
Hispanic	-0.068	0.707	0.507	0.195	0.205	0.038	-0.394	0.030
Standard deviation	1.837	1.096	1.052	0.945	0.850	0.641	0.462	0.278
Proportion of Variance	0.422	0.150	0.138	0.112	0.090	0.051	0.027	0.010

A principal component analysis was carried out on the following socioeconomic and race/ethnicity factors: the percent of the population below the poverty line (Poverty); the logged median household income (Income); the percent of the population that has graduated high school (High School); the percent of the population that has graduated college (College); the unemployment rate (Unemployment); the percent of the population that is black (Black); the percent of the population that is American Indian, Native Alaska, or Native Hawaiian (Native); and the percent of the population that is Hispanic (Hispanic). The top portion of the table shows the variable loadings for each component while the bottom portion shows the standard deviation and the proportion of variance explained by each component.

eTable 5: Principal component analysis of behavioral and metabolic risk factors.

	Component				
	1	2	3	4	5
Obesity	-0.468	0.141	0.321	-0.756	-0.293
Inactivity	-0.468	-0.085	0.586	0.295	0.586
Smoking	-0.385	-0.850	-0.202	0.102	-0.280
Hypertension	-0.459	0.208	-0.715	-0.157	0.458
Diabetes	-0.451	0.455	-0.040	0.553	-0.532
Standard deviation	1.987	0.740	0.468	0.397	0.359
Proportion of Variance	0.789	0.109	0.044	0.032	0.026

A principal component analysis was carried out on the following behavioral and metabolic risk factors: obesity prevalence (Obesity); no leisure-time physical activity prevalence (Inactivity); cigarette smoking prevalence (Smoking); hypertension prevalence (Hypertension); and diabetes prevalence (Diabetes). The top portion of the table shows the variable loadings for each component while the bottom portion shows the standard deviation and the proportion of variance explained by each component.

eTable 6: Principal component analysis of health care factors.

	Component		
	1	2	3
Insurance	0.627	-0.262	0.734
Quality	0.606	-0.429	-0.670
MDs	0.491	0.864	-0.110
Standard deviation	1.291	0.890	0.735
Proportion of Variance	0.556	0.264	0.180

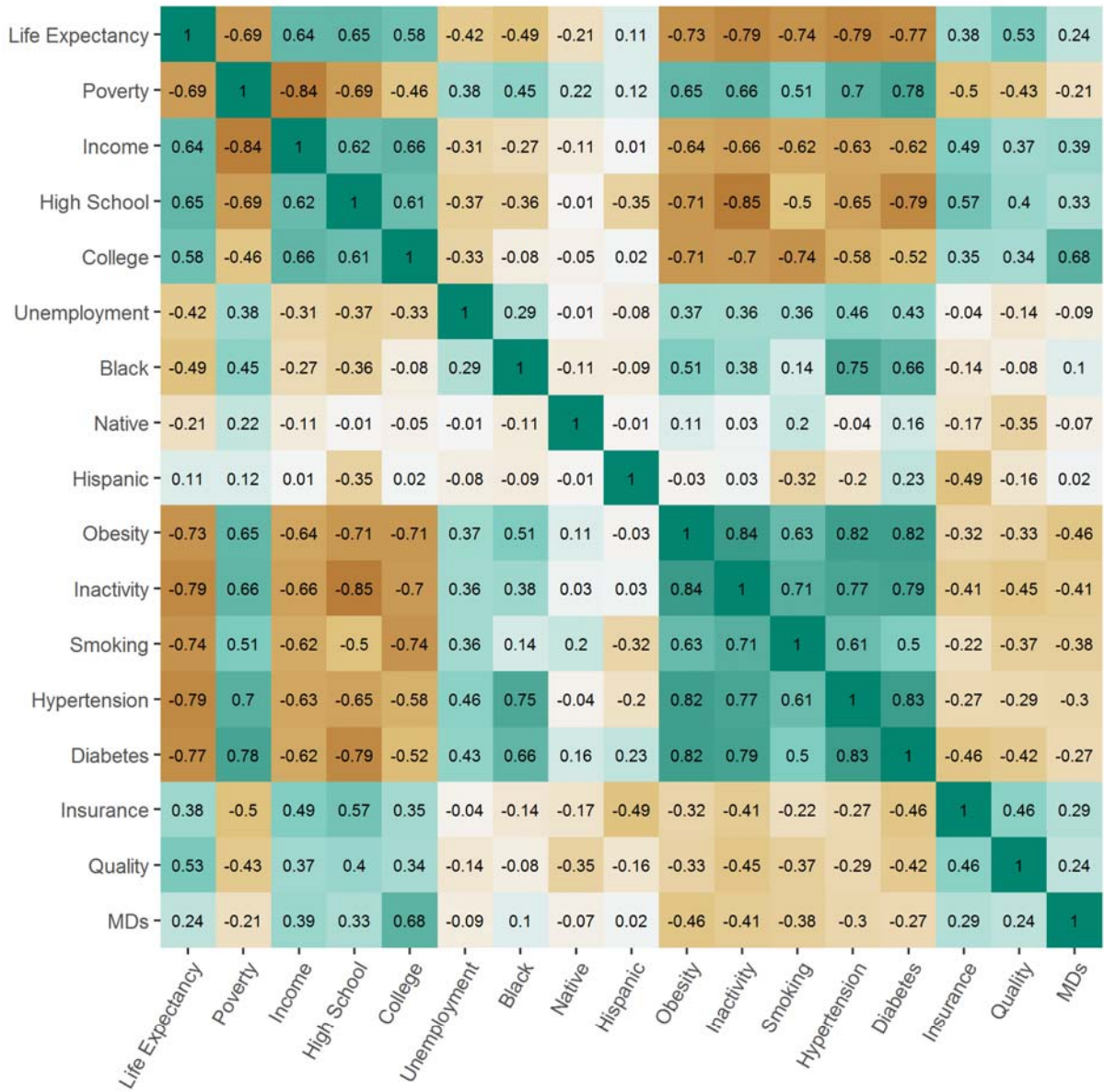
A principal component analysis was carried out on the following health care factors: insurance prevalence under age 65 (Insured); health care quality index (Quality); doctors per 1,000 population (MDs). The top portion of the table shows the variable loadings for each component while the bottom portion shows the standard deviation and the proportion of variance explained by each component.

eTable 7: Multivariate regression models.

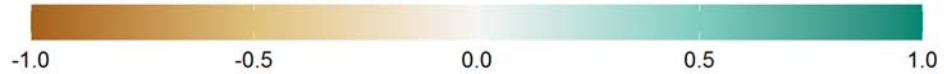
Variable	Model 1	Model 2	Model 3	Model 4
Intercept	69.264* (2.613)	92.546* (0.258)	66.167* (0.497)	85.935* (2.164)
Poverty	-0.077* (0.009)			0.022* (0.008)
Income	0.006 (0.231)			0.489* (0.185)
High School	0.104* (0.006)			-0.027* (0.007)
College	0.061* (0.004)			-0.011* (0.005)
Unemployment	-0.037* (0.008)			-0.031* (0.006)
Black	-0.036* (0.002)			0.002 (0.003)
Native	-0.049* (0.003)			-0.017* (0.003)
Hispanic	0.038* (0.002)			0.011* (0.003)
Obesity		0.065* (0.010)		-0.002 (0.010)
Inactivity		-0.070* (0.008)		-0.092* (0.011)
Smoking		-0.206* (0.007)		-0.154* (0.009)
Hypertension		-0.148* (0.011)		-0.174* (0.019)
Diabetes		-0.334* (0.017)		-0.235* (0.028)
Insurance			0.062* (0.007)	0.037* (0.005)
Quality			0.086* (0.003)	0.034* (0.002)
MDs			0.199* (0.035)	-0.301* (0.026)
R-squared	0.69	0.77	0.31	0.82
Adj. R-squared	0.69	0.77	0.31	0.82
				*p < 0.05

Regression results from multivariate ordinary least squares regressions with life expectancy at birth as the outcome variable. Three sets of variables were considered: socioeconomic and race/ethnicity factors (the percent of the population below the poverty line [Poverty]; the logged median household income [Income]; the percent of the population that has graduated high school [High School]; the percent of the population that has graduated college [College]; the unemployment rate [Unemployment]; the percent of the population that is black [Black]; the percent of the population that is American Indian, Native Alaska, or Native Hawaiian [Native]; and the percent of the population that is Hispanic [Hispanic]), behavioral and metabolic risk factors (obesity prevalence [Obesity]; no leisure-time physical activity prevalence [Inactivity]; cigarette smoking prevalence [Smoking]; hypertension prevalence [Hypertension]; and diabetes prevalence [Diabetes]), and health care factors (insurance prevalence under age 65 [Insured]; health care quality index [Quality]; doctors per 1,000 population [MDs]). The numbers in parentheses are the standard errors for the estimated coefficients.

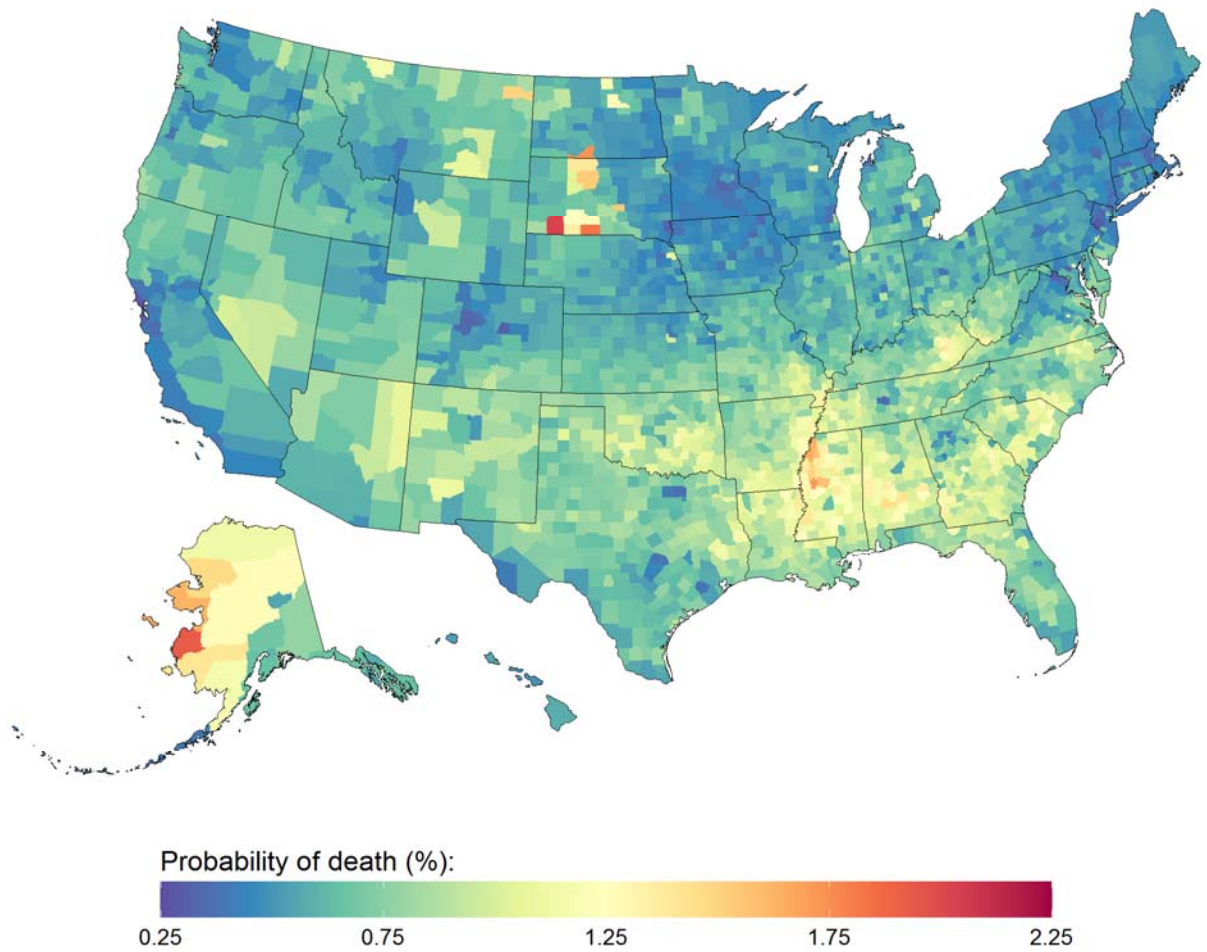
eFigure 1: Correlation matrix for variables included in the regression analysis of variation in life expectancy.



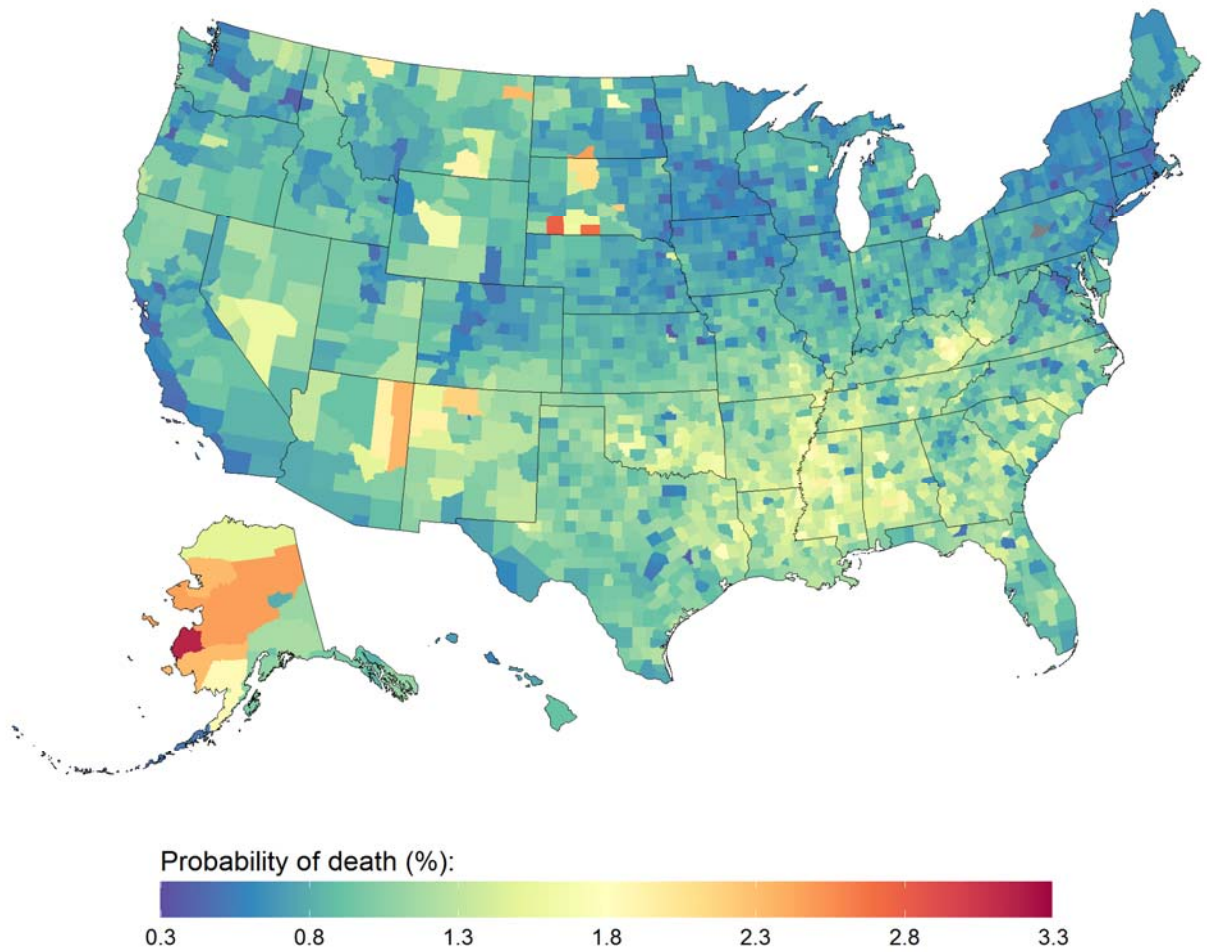
Pearson correlation coefficient:



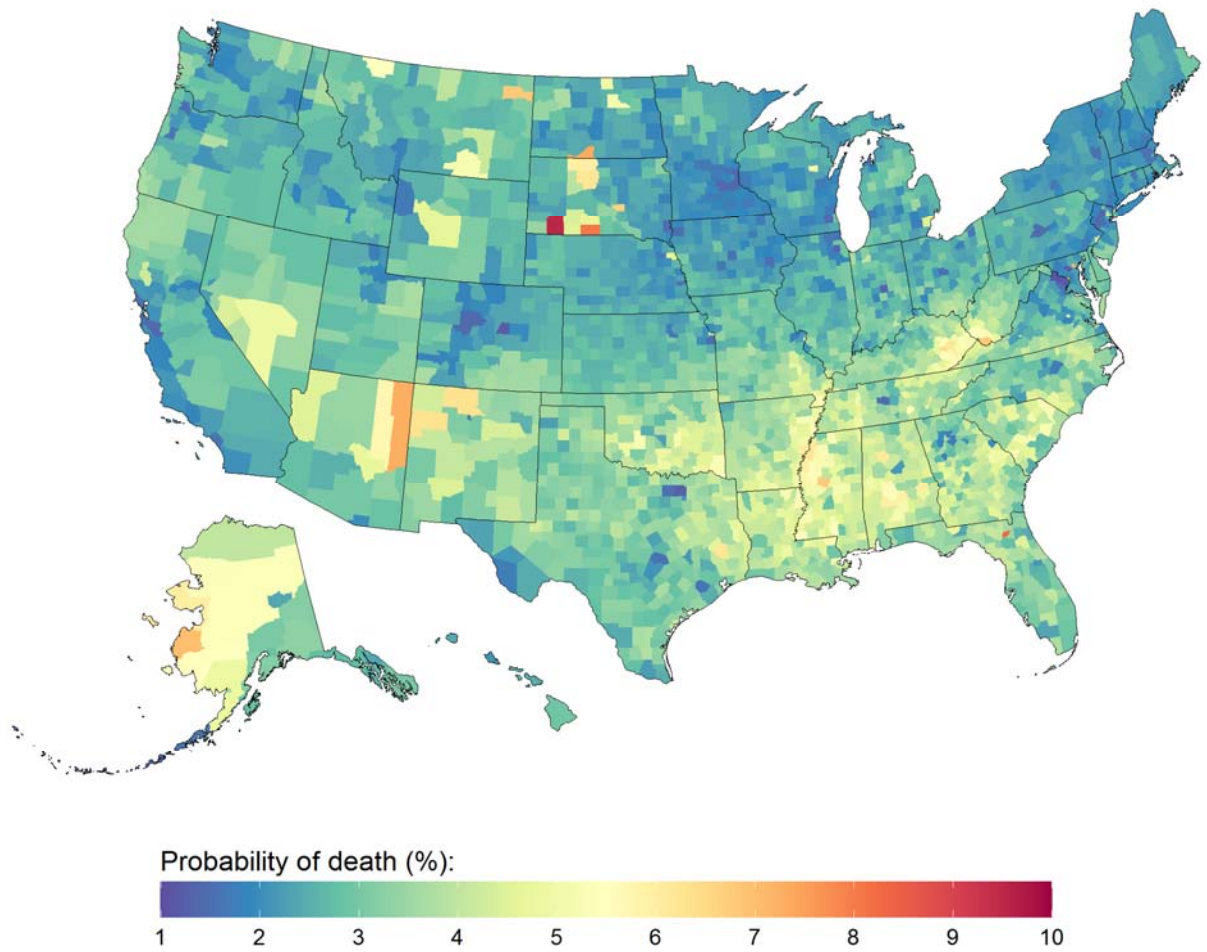
eFigure 2: Probability of death between age 0 and 5 (${}_5q_0$) by county, 2014.



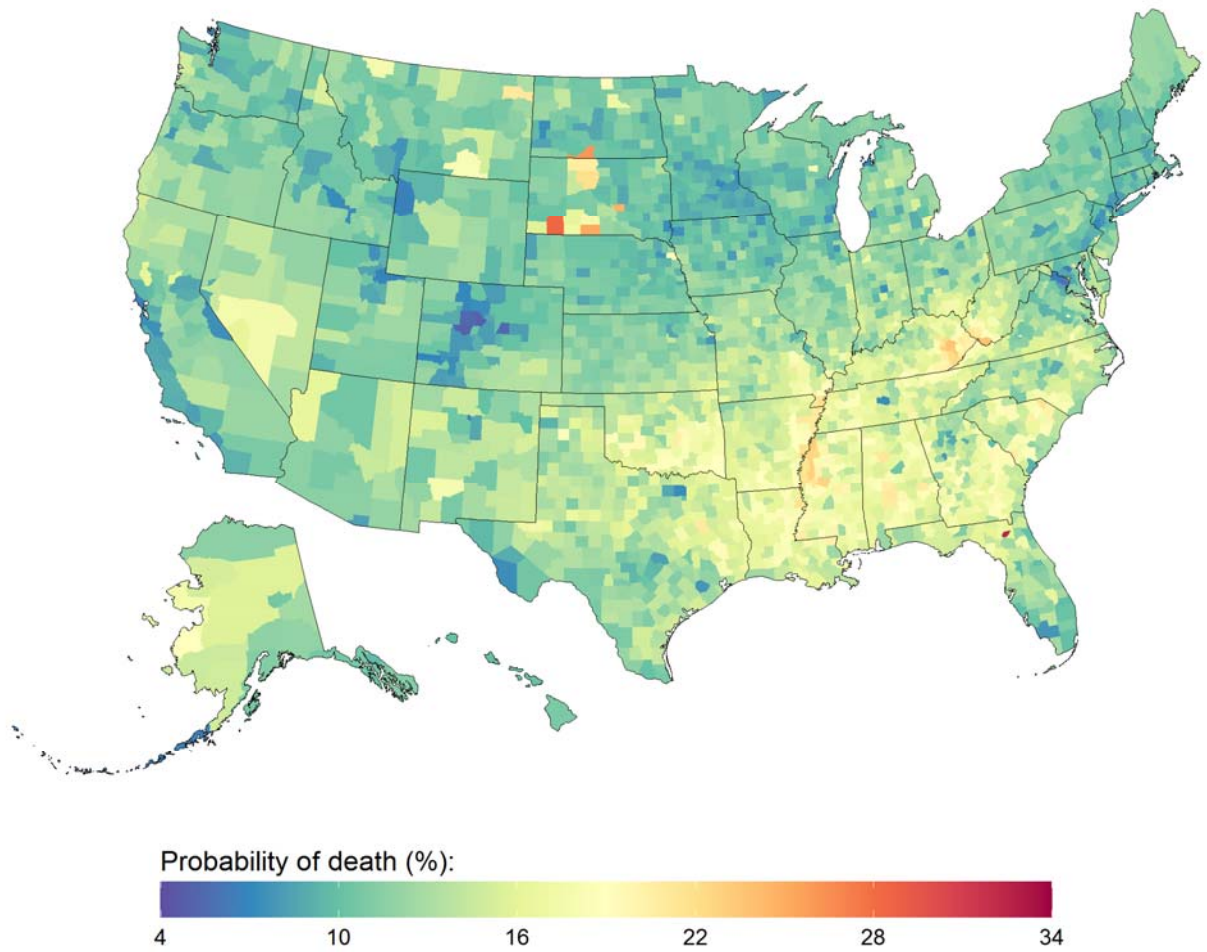
eFigure 3: Probability of death between age 5 and 25 ($_{20}q_5$) by county, 2014.



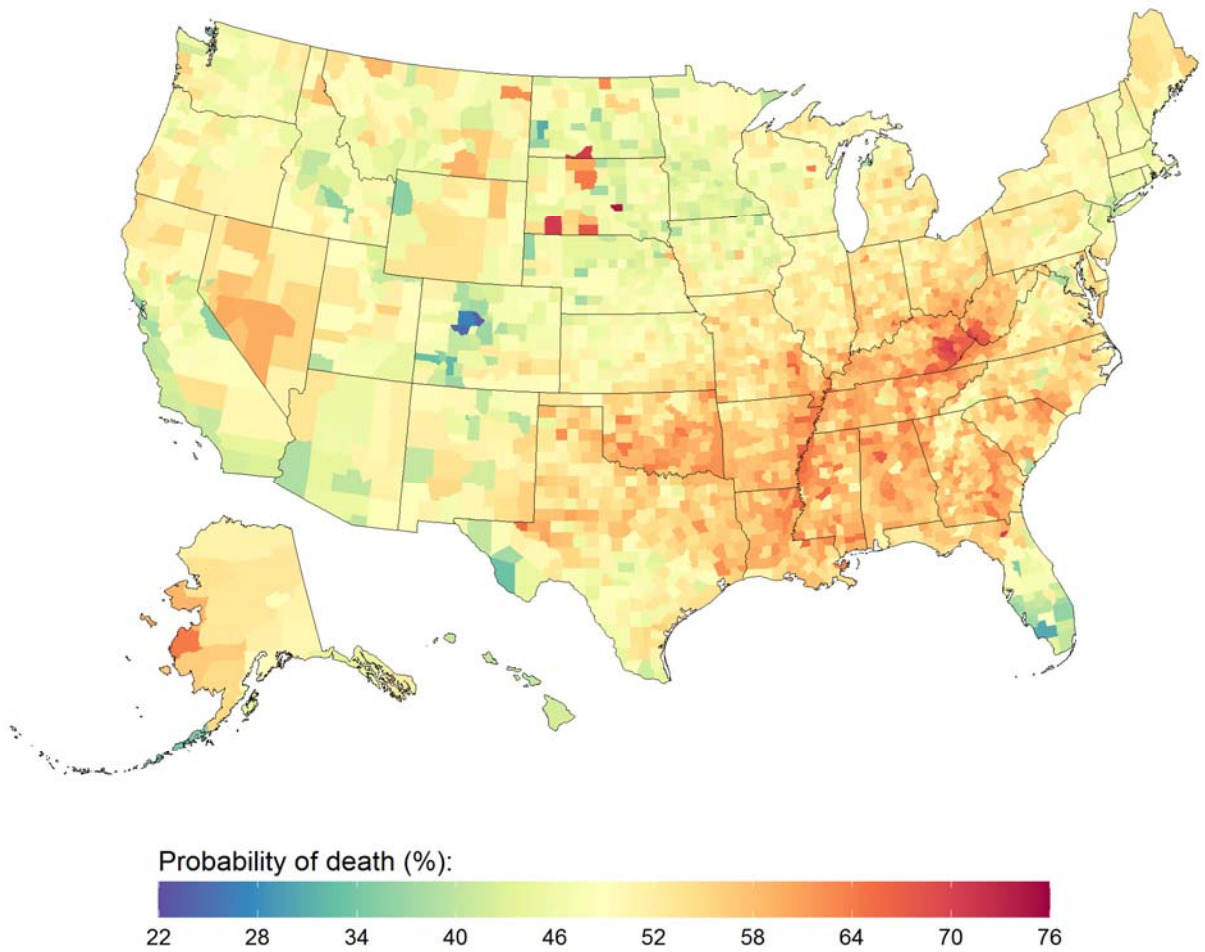
eFigure 4: Probability of death between age 25 and 45 (${}_{20}q_{25}$) by county, 2014.



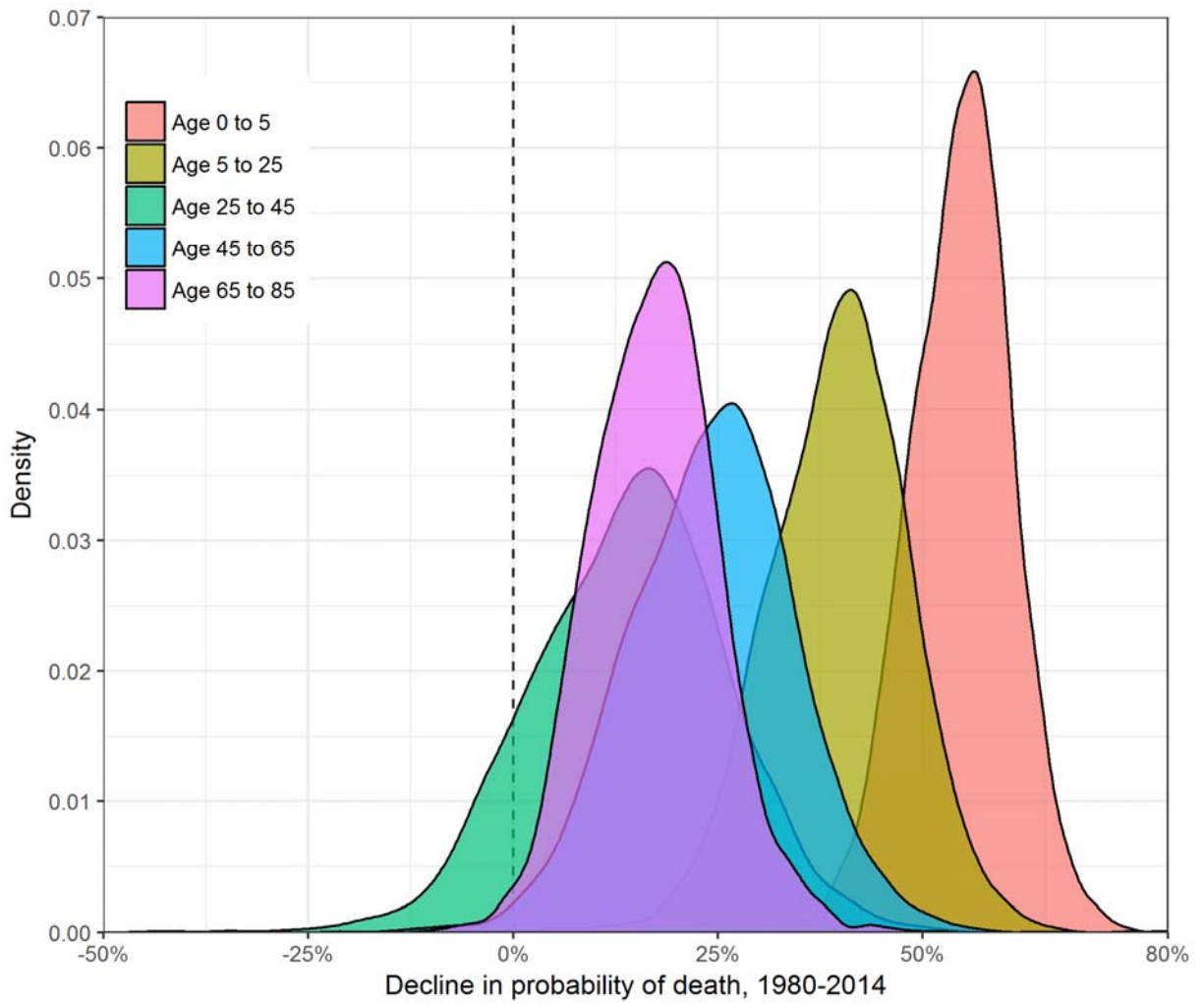
eFigure 5: Probability of death between age 45 and 65 (${}_{20}q_{45}$) by county, 2014.



eFigure 6: Probability of death between age 65 and 85 (${}_{20}q_{65}$) by county, 2014.



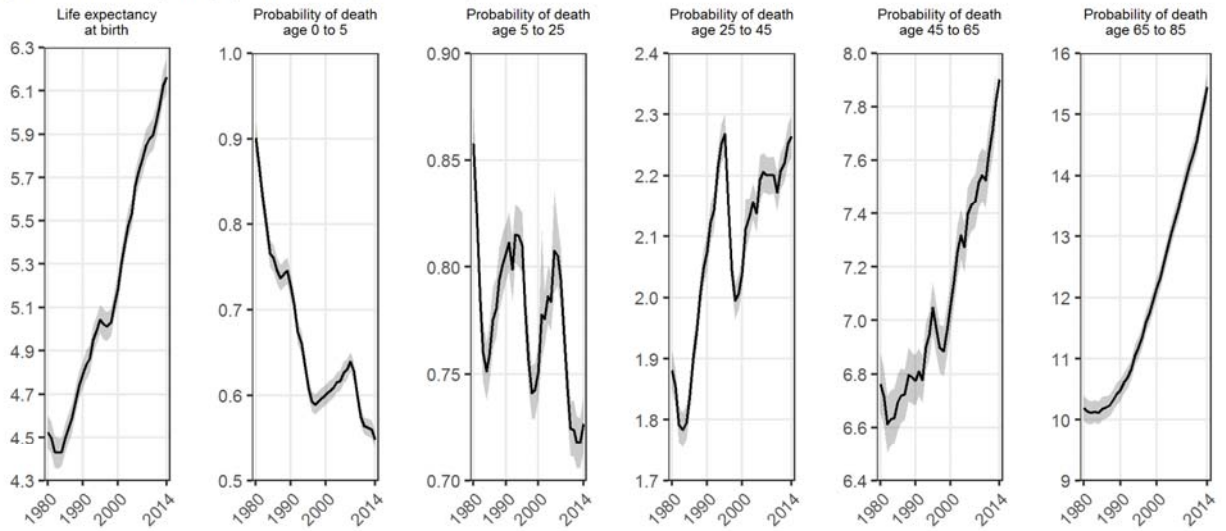
eFigure 7: Distribution of county-level declines in age-specific mortality risks, 1980-2014.



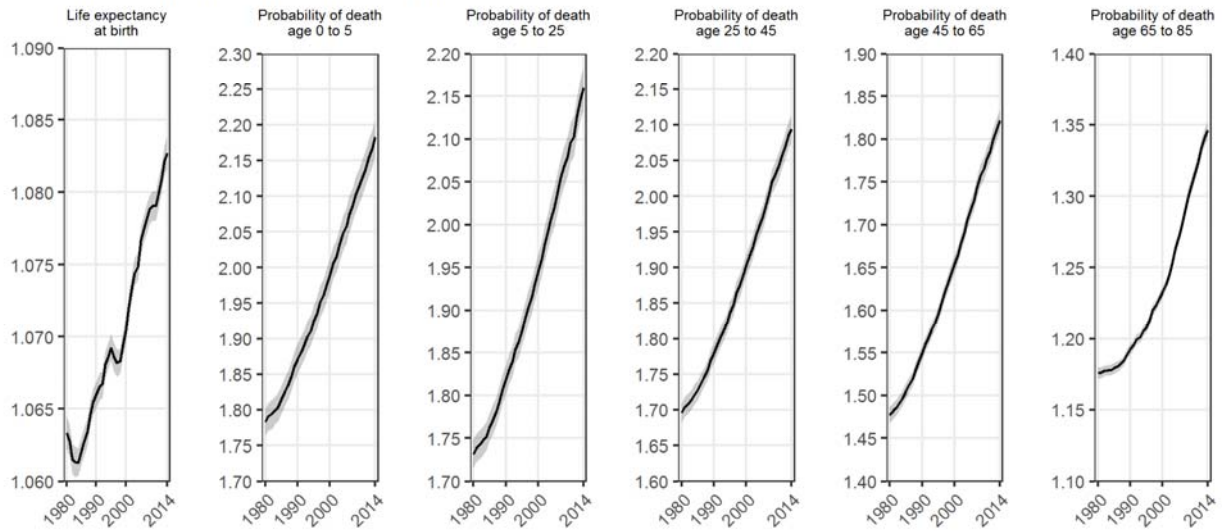
Density plot (smoothed histogram) of the percent decline in age-specific mortality risks between 1980 and 2014 for 3,110 counties. Colors indicate age group, as described in the plot key.

eFigure 8: Absolute and relative inequality among counties in life expectancy and age-specific mortality risks, 1980-2014.

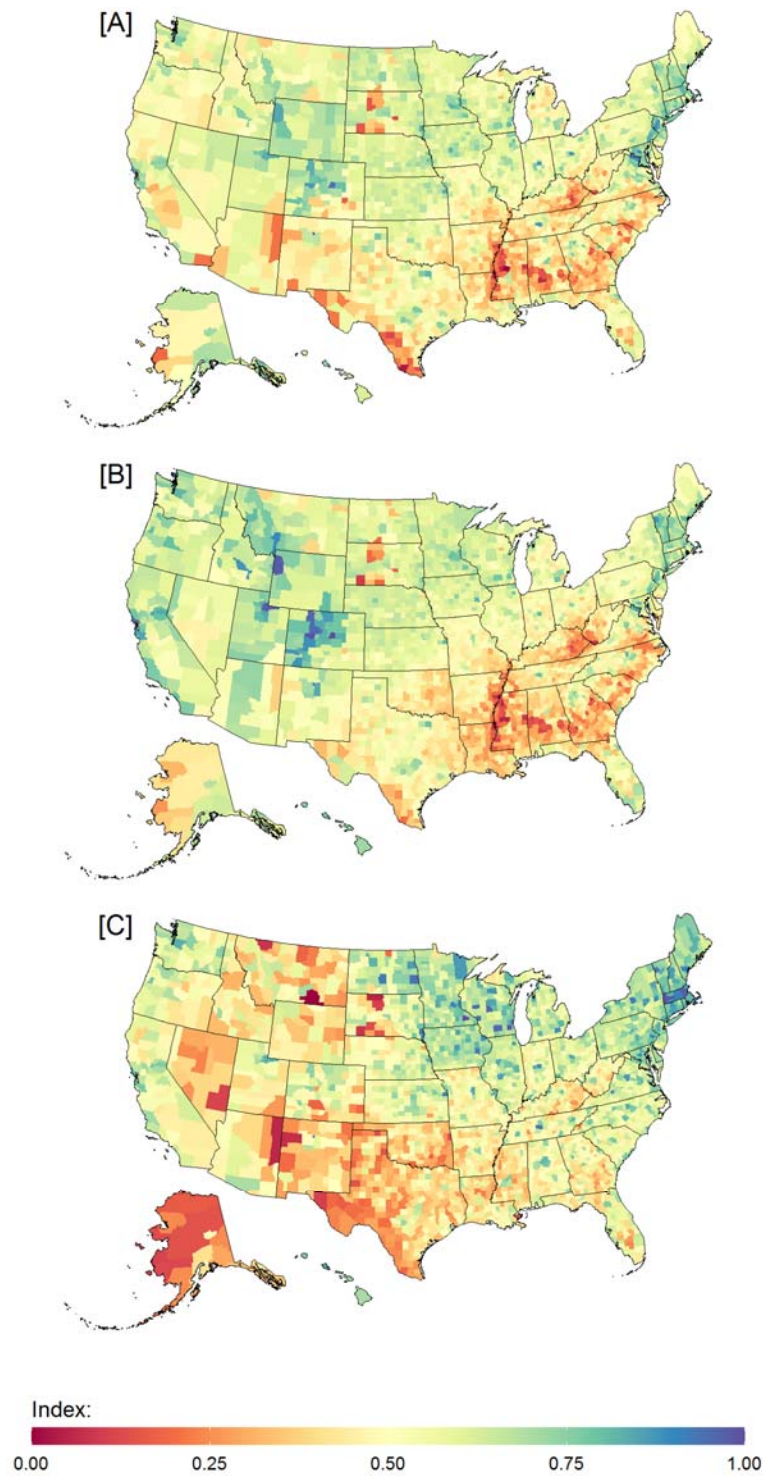
[A] Absolute inequality (90th - 10th percentile)



[B] Relative inequality (90th/10th percentile)



eFigure 9: Index of socioeconomic and race/ethnicity factors, behavioral and metabolic risk factors, and health care factors by county, 2009.



[A] Socioeconomic and race/ethnicity factors index; [B] Behavioral and metabolic risk factors index; [C] Health care factors index.